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THE VARIABILITY OF STEPHANODISCUS HANTZSCHII GRUN
[Ueber die Variabilitaet von Stephanodiscus hantzschii Grun]

by

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ABSTRACT

A new variety, *striatior*, of the diatom *Stephanodiscus hantzschii* GRUN. *(S.h.)* with denser striae was described (KALBE 1971). The legality of *S.h.* var. *pusillus* is confirmed by specimens from freshwaters of the north of Mecklenburg. The species *S.h.* probably consists in this region of several races with different peaks of valve diameter variation. The planctonic mass changing of *S.h.* and its forms in the three rivers Warnow, Malchiner Peene and Neukalener Peene and in the Lake Kummerow is represented. The differences of the average valve sizes in these waters are remarkable. Var. *pusillus* GRUN. appears to be a benthic mass form, too. High cell numbers and high cell volume sums are not developing ever simultaneously. Var. *pusillus* is not a suitable form for evaluating the saprobiological status, for it is adaptable to different ecological conditions. The species *S.h.* itself is a beta- to alphamesosaprobic organism, being able to produce high cell numbers within this range of saprobity.

The centric Stephanodiscus hantzschii Grun (S. h.) is found in large numbers in the eutrophic bodies of water of the Baltic region, particularly in north Mecklenburg (Keil 1963, Kalbe 1965). The river Warnow, which empties into the

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Baltic near Rostock, Lake Kummerow (LK), and its tributaries Malchiner Beene (MB) and Neukalener Beene (NB) were studied one or more times a month, the first in 1969-1971, and the other three in 1967-9169. These studies were reported in detail elsewhere (Kalbe 1971). Other Stephanodiscus species in the region are S. astraea with var. minutula, S. dubius, S. tenuis, and S. binderanus.

In the diagnosis of S. h., Hustedt (1930a, 1930b) states that the radial striae are "often just shadowy traces," that the cell diameter is about 8-20 µm, and that there are 8-10 radial lines (!) and peripheral spines in 10 µm. In spite of the minimum size cited, shells are often found which are only 6-7 µm in diameter, sometimes as small as 4 µm. On the other hand, specimens 18-28 um in diameter have been observed (Nipkow, 1927), and diameters as large as 30 um in NB. There is no agreement in the literature with regard to the taxonomic legitimacy of varieties and genetically different forms with varying shell diameters. Hustedt (1930a, 1930b) rejects such varieties, "since distinguishing between them is practically impossible." A. Cleve-Euler (1951) distinguishes S. h. delicatus A. Cl. with 12-19 µm from S. h. pusillus Grun with 4.2-12 µm diameter. Fig. 1 shows the variability in size, in addition to a certain structural independence of the smallest cells (b in Fig. 1), which are identical with var. pusillus, together with var. striator first described by the author (Kalbe 1971) (Fig. 1(a) and Fig. 2). Stephanodiscus hantzschii Grun

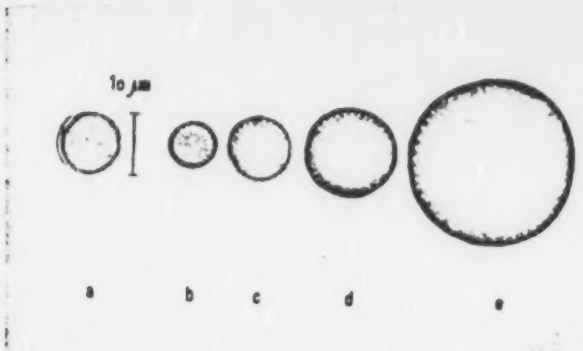

Fig. 1: Stephanodiscus hantzschii with var. striator (a), var. pusillus (b), and various large shells of the species (c-e).

var. striator Kalbe has the following characteristics:

Cells living singly, planktonically, or tychoplanktonically. Shells flat, drum-shaped; diameter 8-14 µm. Striae faint, 15-18 per 10 µm, becoming very faint toward the center, ending in the center in a very faint, small circular structure, with one or more faint points near it. With peripheral spines. Differs from type by denser striation of shells. Fig. 2.

Gerloff and Goelz (1944) showed a picture of an electron-optically magnified specimen of S. h., which exhibited both the central points and the central circular structure in the same manner as in S. h. striator.

The samples studied were scooped from the surface. This appeared justified not only for the three rivers, but also for the almost constantly wind-mixed LK. The counts were made with the plankton microscope, following the recommendations of

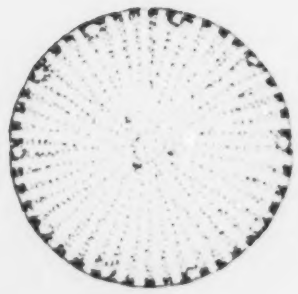

Fig. 2: Stephanodiscus hantzschii Grun var. striator Kalbe

Untermoehl (1958). The numbers of cells or individuals were divided into abundance classes, in order to simplify the representation and reflect the bifurcation of the cells.

Abundance class	Number of individuals ind./ml	Class mean ind./ml
1	0- 10	5
2	11- 25	18
3	26- 50	38
4	51- 100	75
5	101- 200	150
6	201- 400	300
7	401- 800	600
8	801- 1,500	1,150
9	1,501- 3,000	2,250
10	3,001- 6,000	4,500
11	6,001- 12,000	9,000
12	12,001- 25,000	18,000
13	25,001- 50,000	37,500
14	50,001-100,000	75,000

From each monthly sample, 50 shells were measured in the sterilized Hyrax preparation. With the aid of calibration curves, the cell volumes and total volume (sum of volumes per ml of sample) were calculated separately for each body of water from the diameters and the lengths of the pervalvar axis (shell heights).

Results

Fig. 3 shows the fluctuations in the Warnow of the individual abundance, the mean shell volume, and the cumulative volume of S. h., including the varieties. Increases in mass occur in late winter and early spring with values of 7000-8000 ind./ml. Large cumulative volumes and large numbers of individuals do not always coincide.

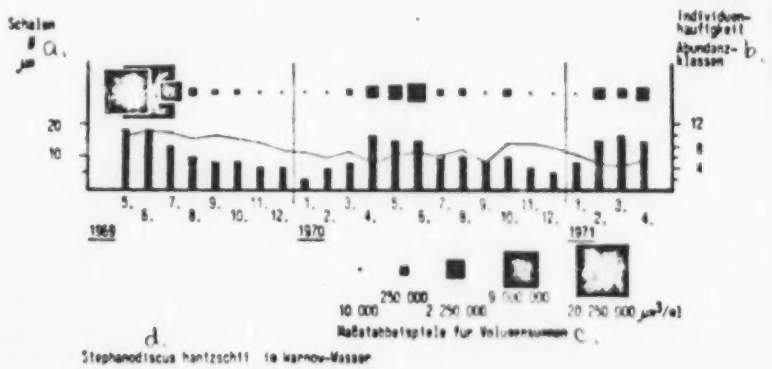

Fig. 3: Variation in mass of Stephanodiscus hantzschii and its varieties in the water of the Warnow near Rostock. Columns: abundances. Curve: mean shell diameter. Black squares: total volume/ml. Abscissa: Period of study. The cumulative-volume scale is below the diagram.

Key:
a. Shell diameter
b. Abundance class
c. Illustrations of cumulative-volume scale
d. Stephanodiscus hantzschii in the water of the Warnow

Fig. 4 gives the same information for LK and its tributaries MP and NP. In LK, the spring abundance peaks are the largest, while the diatoms in the rivers often multiply strikingly in the second half of the year, particularly in NP and the Warnow. The mean diameter of the shells is smaller in LK. The small shells of var. pusillus are also found in the sediments of LK, almost to the exclusion of other shell diameters. The maximum volumes were observed in May and June of 1969 in the NP and the Warnow, while the number and mass of cells were already decreasing in LK.

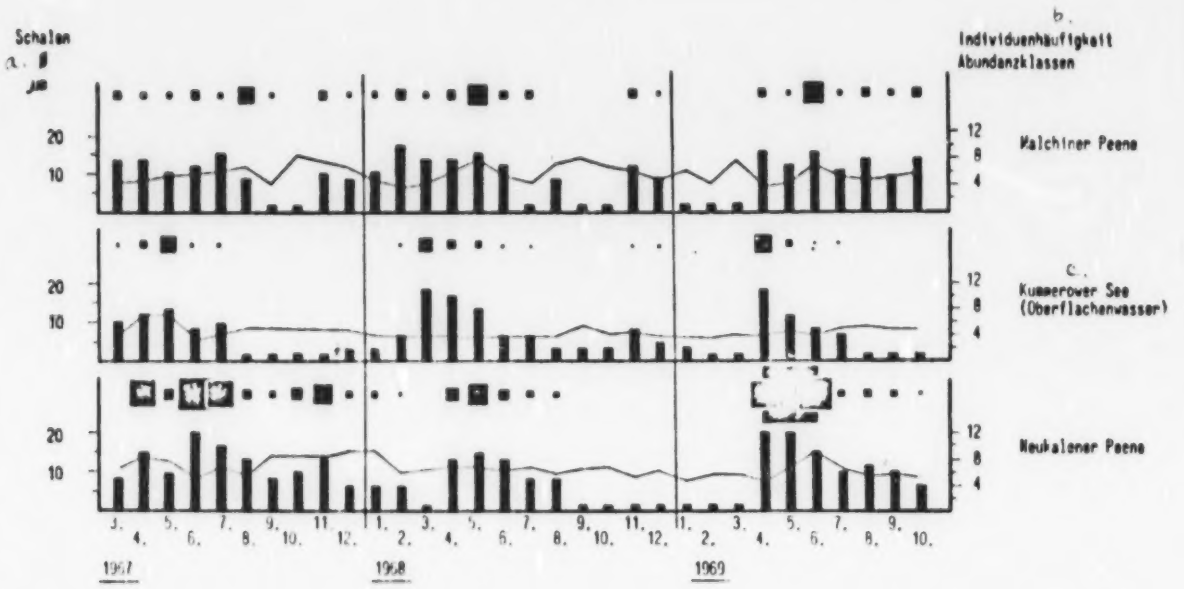

Fig. 4: Variation in mass of Stephanodiscus hantzschii and its varieties in the waters of Malchiner Peene (MP), Neukalener Peene (NP), and Lake Kummerow (LK). Otherwise as in Fig. 3.

Key: a. Shell diameter
b. Abundance class
c. Lake Kummerow (surface water)

The mean values of shell size are collected in the following summary:

	mean diameter	scatter s	mean shell height	mean shell volume
Lake Kummerow	7.04 µm	± 0.94 µm	3.68 µm	143 µm³
Malchiner Peene	8.88	2.14	4.91	304
Neukalener Peene	10.25	2.92	5.97	493
Warnow near Rostock	13.71	2.73	9.31	1378

More informative is Fig. 5, in which the percentage distribution of shell diameter is depicted for each body of water over the entire study period. Gaps in the rows of columns mean that few if any shells were encountered in the associated diameter class. Above 23 µm, there were very few shells in the material. There were gaps in the shell-diameter sequence at the same points in all four bodies of water, namely at 9-10, 13-14, and 18-19 µm. The peaks of the size distribution are at the class centers 10.5, 12.5, 15.5, and 19.5 µm. The author is inclined to view this as evidence for the existence of races with different sizes. Bursche (1961), who worked with monocultures of S. h. from Ploen waters, obtained cells with little variation in shell diameter when different nutrient solutions were employed. 70% of the cells had a diameter of 10.5 µm.

The low variability of shell diameter of S. h. from LK suggests that the morphological variety pusillus Grun should be retained. Larger shells are rarely found in LK; they either are associated with auxosporulation, come from MP or NP,

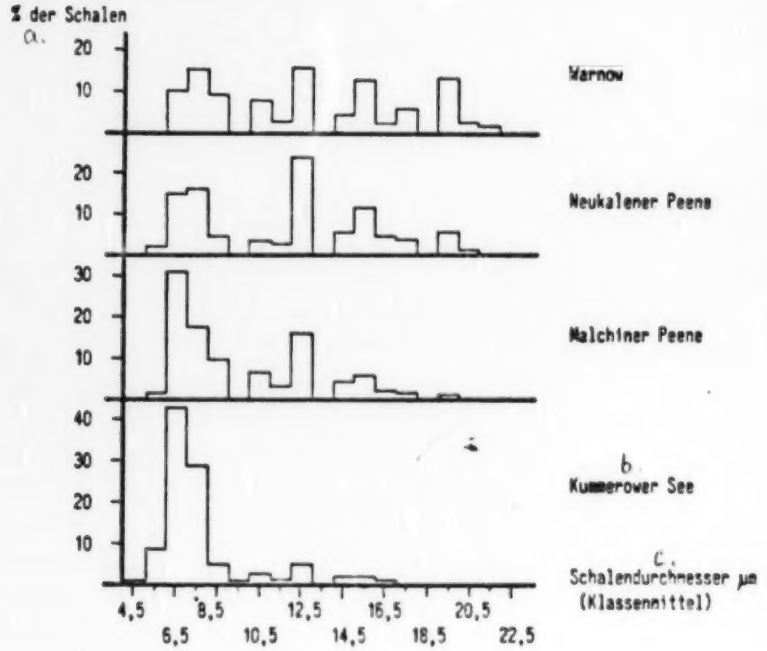

Fig. 5: Percentage distribution of shell diameter of Stephanodiscus hantzschii and its varieties in the Warnow, Neukalener Peene, Malchiner Peene, and in Lake Kummerow. Distribution classified by size (class mean).

Key: a. % of shells
b. Lake Kummerow
c. Shell diameter (class mean)

or are descendants of such imported cells. The small shells of the rivers also belong to var. pusillus, as was shown by analyses of growth on suspended glass slides (Kalbe 1971). The variety appears in the region in the young form during February and March, and populates the bodies of water from the sediment and the riparian zone. Nipkow (1927) showed that algae can form spores which survive the winter in the sediment and can still germinate after many years.

Discussion

Nipkow's small shells from Lake Zurich were probably var. pusillus. On the basis of several pennate and centric diatoms, however, he came to the conclusion that the size variations in the shells of S. h. occur as part of auxosporulation and cell diminution in multi-year periods. Lake Zurich was initially populated by S. h. in 1900. At first, shells only 8 µm in diameter were deposited in the sediment. Following 1908, a second peak appeared between 10 and 13 µm, with a simultaneous relative reduction in the proportion of the small shells. In auxosporulation, the cells should grow from 6 to 14 µm. However, the cell photographed by Nipkow, which was claimed to be an auxospore daughter shell, measured only 12 µm. The second diameter peak (in his Table 14), on the other hand, does not go below 12 µm -- it appeared as the trophicity of Lake Zurich was on the rise, so that it does not appear unwarranted to conjecture that this was a form or race of S. h. different from var. pusillus and preferring a higher nutrient concentration. The author does not think it likely that cells coming directly from pusillus auxospores would be capable of forming and independent size peak separated from that of the very small cells by a gap or frequency depression in the size distribution.

Utermoehl (1925) found 7 µm as the mean diameter for var. pusillus in Ploen lakes, from which, with an average

shell height of 4.4 µm, he calculated a mean volume of 170 μm^3. S. h. remains problematic as the principal form of the contamination, which can be seen from the fact that the statements on its occurrence range from polysaprobity (Cleve-Euler 1951) to oligotrophy (Huber-Pestalozzi 1942). S. h. is in no way characteristic of an alphamesosaprobic environment, since it is also capable of increases in mass under betamesosaprobic conditions (Keil 1963, Sramek-Husek 1956, Zelinka and Sladecek 1964). As far as the auto-ecology, Hustedt (1957) termed it oligohalobic, euryoxybiont, and alkaliphilic, while Simonsen (1962) viewed it as a meso-euryhaline effluent form. In the Werra and Wipper, up to 5000 mg/l Cl was tolerated (Ziemann 1970).

The observations reported here -- that there are several shell-diameter peaks within the species Stephanodiscus hantzschii -- is quite consistent with the view of Margalef (1969) that some centric diatoms can be polymorphic. As Bethge (1925) had before him with Melosira islandica ssp. helvetica, he found with the marine Melosira sulcata as well (p. 203) "that, at least in some Melosira, populations are polymorphic, made up of a mixture of recurrent size groups, that appear as discontinuous peaks in the curves expressing distribution of individuals in different size classes." Of the "otherwise excellent papers by Nipkow," Margalef wrote (p. 202) "the acceptance of an obligate alternation of auxosporulation and periods of regular decrease of size has been an obstacle to further analysis."

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